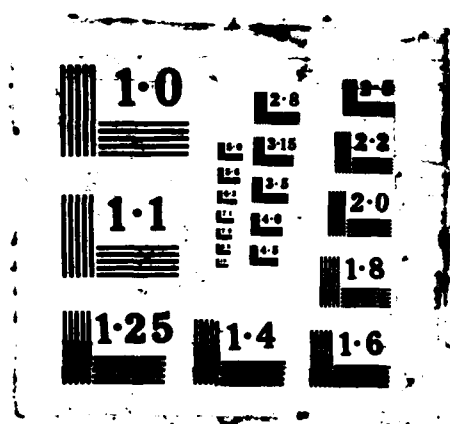


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DEPT OF MATHEMATICS AND STATISTICS W A ROSENKRANTZ
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19. ABSTRACT (Continue on reverse if necessary and identify by block number) <div style="float: left; transform: rotate(-90deg); transform-origin: left top; white-space: nowrap;">DTIC FILE COPY</div> <p>> This report described Professor Rosenkrantz' research activities at INRIA (FRANCE) as well as other professional interactions. There is a list of publications and a brief report on the status of his current research on Biostability, approximate counting and related problems.</p> <div style="text-align: right;"> DTIC ELECTE FEB 24 1987 </div>			
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I. PUBLICATIONS (WALTER A. ROSENKRANTZ)

1. Birth and Death Process Approximation for the Slotted Aloha Algorithm (with W. Rising), AFOSR 82-0167, Technical Report No. 12.
2. Some Remarks on the Asymptotic Length of a Collision Resolution Interval, AFOSR 82-0167, Technical Report No. 13. Note: This paper has been accepted for publication in the IEEE Trans. On Communications.
3. Approximate Counting: A Martingale Approach. AFOSR82-0167 Technical Report. Note: This paper has been accepted for publication in "Stochastics".

II. INVITED LECTURES

1. Imperial College (London), Department of Electrical Engineering; 14 Nov. 1985.
Title: Modeling and Analysis of Random Access Communication Systems.
2. Cambridge University, Statistical Laboratory, 15 November 1985.
Title: An Operator Method for Computing the Asymptotics of a Collision Resolution Interval.
3. INRIA (France)
Title: An Operator Method for Computing the Asymptotics of a Collision Resolution Interval.
4. Univ. of Paris VI, Seminaire de laboratoire de Probabilités, 14 Jan. 1986.
Title: Recent Results of ALDOUS on Random Access Communication Systems.
5. Stichting Mathematisch Centrum (CWI), Amsterdam, Holland 14 April 1986.
Title: Modeling and Analysis of Communication Protocols for Random Access Communication Systems.
6. University of Utrecht, Department of Mathematics, 17 April, 1986.
Title: An Operator Method for Computing the Asymptotics of a Collision Resolution Interval.
7. INRIA (Sophia Antipolis), Journées D'études, Modelisation et Évaluation de Systemes Informatique, 29 April 1986.
Title: A Martingale Approach to Approximate Counting.

III. PROFESSIONAL INTERACTIONS

- a. For the 1985-1986 year I had an appointment as Directeur Scientifique at INRIA (Rocquencourt) France and was also supported in part by the AFOSR and the University of Massachusetts. During my stay I benefitted from consulting with my colleagues Guy Fayolle, Francois Baccilli and Phillipe Robert who are members of Project "MEVAL" which is the French acronym for "Méthodes d'évaluation de Performance".

It was F. Baccelli who pointed out to me that the pure birth Markov chain occurring in the analysis of the Exponential Backoff Protocol (EBO) is related to the probabilistic algorithm "Approximate Counting", which had already been studied via Mellin transforms by F. Flajolet (INRIA). In my paper "Approximate Counting" I devised a martingale approach which yields Flajolet's results with much less effort.

- b. In addition to working with my colleagues here at INRIA I was invited to lecture in England, Holland, and the University of Paris VI which led to useful conversations with Professors M. H. A. Davis (Imperial College, London), Frank Kelly (Statistical Laboratory, Cambridge, England), Onno Boxma (CWI Amsterdam), J. W. Cohen (University of Utrecht), J. Jacod and Claude Kipnis (both of University of Paris VI).

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IV. STATUS OF CURRENT RESEARCH (Walter A. Rosenkrantz)

Current research is focused on 3 problems:

(i) A quantitative analysis of bistability for slotted ALOHA; (ii) Does biostability exist for EBO?; (iii) Tests for positive recurrence of multi-dimensional queueing processes satisfying boundary conditions.

(i) We consider the slotted ALOHA algorithm with N users, $N < \infty$, p_0 = prob. terminal becomes active, p_1 = retransmission probability. For certain choices of N , p_0 , p_1 the slotted ALOHA algorithm is known to exhibit bistability. This means that the system spends most of its time in one of two stable states which we label m and M respectively. In state m the system runs with short delays and reasonably good throughput while in state M terminals are in the retransmission mode with a relatively high rate of collisions and therefore low throughput. One of the most important questions for design engineers is to estimate the amount of time required for the system to flip from state m to state M . WE have recently devised a novel approach to this problem by renormalizing the process in such a way that the diffusion term is small relative to the drift term. This leads to what I would call "a small noise diffusion approximation". The resulting process is similar to one analyzed recently by C. Kipnis and C. Newman in the SIAM J. APPL. MATH. Vol. 45, No. 6. There are important differences however which complicate the calculations. For example we have a boundary condition at 0 that cannot be ignored and the diffusion, though small, is not constant. The final result we are aiming for is a simple computable formula for the time to collapse of an N user slotted ALOHA as a function of N , p_0 , p_1 . We then intend to compare this formula with the exact result which can be computed by inverting an

$(N - 1) \times (N - 1)$ matrix. These calculations will be carried out by my student W. Rising.

(ii) It is undoubtedly true that bistability exists for EBO but to detect it via simulation could take an extraordinary amount of computer time. We are searching for a theoretical model from which we will be able to predict under what conditions bistability exists. Then we propose to estimate the amount of time required to flip from state m to state M - a much more difficult problem, since we will be doing "large deviations analysis" in a multi-dimensional space.

(iii) If one modifies the ALOHA algorithm or the ethernet systems to allow buffers at each terminal then the ergodicity analysis of the queueing network is complicated by the boundary conditions to be imposed when one or more of the queues is empty. Similar problems arise when one imposes a "load balancing protocol" on N processors. I have just begun a joint research project with Dr. Baccelli of INRIA on these and related problems.

V. PROFESSIONAL PERSONNEL ASSOCIATED WITH RESEARCH EFFORT

Mr. W. Rising is working with me on a quantitative analysis of biostability for both the slotted ALOHA algorithm and EBO (= ethernet) protocol. The result would be a Ph.D. thesis for Mr. Rising.

END

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